CHEMICAL CONTROL OF HENBIT AND CHICKWEED IN KENTUCKY BLUEGRASS TURF

by

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INTRODUCTION

Common chickweed (Stellaria media) and henbit (Lamium amplexicaule L.) are winter annuals which become established in the fall and seriously compete for space during spring and early summer when Kentucky bluegrass turf is best able to spread vegetatively. Both of these weeds are found in home lawns and parks where the usual mowing height favors development of these pests.

Kummer (15) described common chickweed:

> A plant belonging to the family Caryophyilaceae (Pink family) with roots frail and seemingly inadequate. Hypocotyl slender, often reclining. Seed leaves 0.25 x 1 - 2 x 12 mm.; tender; the leafstalk frequently edged with a few unequal clear hairs.
>
> Leaves opposite; tender, crisp, not thin; light green, paler beneath; smooth except for a fringe of a few long hairs on the leafstalk. Leaves strict in the bud, the tip soon spreading. Stem internodes smooth, thereafter with lines of soft pubescence. Buds appearing early in the seed leaf axils. Plant emitting a dusty odor when bruised.

He described henbit as:

> A member of the family Labiatae (Mint family), hypocotyl smooth, often dull purple above ground. Seed leaves 1 x 3 - 4 x 12 mm., if growing in the shade; smooth, a bloom on lower surface; midvein ending in a gland at the leaf tip; lobes at the base merely rounded at first, later distinctly tailed.
>
> Leaves crinkled above by the depressed veins; clothed more or less with soft minute hairs above and on the prominent veins beneath; a powdery bloom beneath; each leafstalk inserted on one side of the nearly square stem, two members of a pair united by a narrow rim. Leaves folded together loosely and lengthwise, one overlapping the margin of the other in the bud. Hairs of the stem directed downward.

Control of these weeds in fall or early spring with a minimum damage to bluegrass would improve turf quality. This study was undertaken to test certain herbicides in order to determine (1) their effectiveness as post-emergence treatments in controlling henbit and common chickweed in Kentucky bluegrass turf, and (2) their effect on the growth and vigor of Kentucky bluegrass.

REVIEW OF LITERATURE

Hogard and Hemphill (13) applied ammonium sulfate at 2 pounds per 100 square feet to an area supporting bluegrass and chickweed. Ammonium sulfate gave 93 percent kill of chickweed with some burning of bluegrass. All evidence of burning disappeared in four weeks and later growth was better than check plots.

Davidson (6) used odorized methyl bromide at 1 pound per 100 square feet applied under a gastight cover at an exposure period of 24 hours. He found that excellent control of chickweed was obtained and bluegrass remained in a normal vigorous condition.

Friesen (8) in tests conducted at the University of Manitoba, Winnipeg, Canada, reported that a June application of neburon at 7.2 pounds to the acre applied to chickweed growing in bluegrass killed the newly emerged chickweed plants. Late in August the effect of the treatment began to wane and by mid-September a stand equal to 20 percent of the original infestation had established itself. In late July neburon at 7.2 pounds per acre was applied to fully developed chickweed in bluegrass sod and within three weeks the weeds were completely dead. Subsequent emergence of chickweed plants were killed by the chemical before they passed the seedling stage.

Daniel (5) found that neburon 1.0 pound per acre applied in September was specific for henbit and chickweed control.

Frosberg (7) found than neburon sprayed on chickweed growing in a Kentucky bluegrass lawn at 1/2, 1, 2, 3, 4, 6, and 8 pounds per acre using 6 gallons of water per acre resulted in one hundred percent kill of chickweed with all treatments in the test.

Goetze and Daniel (10) showed that a post-emergence application of disodium methyl arsonate at 5 and 10 pounds per acre applied to bluegrass turf and chickweed

in October and November gave a good quick vegetative knock down but regrowth developed later. Neburon applied at 4 pounds per acre at the same time gave good control of chickweed which lasted the entire season.

Grigsby (11) reported that a post-emergence application of Stoddard Solvent 1 to 3 quarts per 1000 square feet killed chickweed in four to twelve hours and did not leave a toxic residue or kill roots of perennial grasses.

Bondorenko (4) showed that common chickweed treated with "R.G.B.E. ester of silvex" at 1 and 2 pounds per acre in 40 gallons of water per acre died within three weeks after treatment.

Hogard and Hemphill (12) reported that 2,4,5 T at 3 pounds per acre gave excellent control of chickweed but discoloration of bluegrass was excessive. Excellent control was also obtained with 2,4,5, TP at 1.6 pounds per acre and 2,3,6 - Trichlorobenzoic acid (TBA) 4 pounds per acre with slight discoloration to bluegrass.

Gallagher and Jack (9) reported that 2,4,5-TP at 1.5 pounds per acre, neburon at 2 pounds per acre and Simazin at 4 and 8 pounds per acre produced 100 percent control of annual chickweed regardless of the number of applications. In the perennial chickweed series, 2,4,5-TP at 1.5 pounds per acre and M.C.P.P. (2 - (2 - methyl - 4 - chlorophenoxy propionic acid) at 1.5 pounds per acre produced 100 percent control with one and two applications. Simazin at 4 and 8 pounds per acre killed all cool season turf grasses.

C.M.P.P. amine salt (1) is used extensively in England for the control of chickweed. The recommended rate of application for the control of chickweed is six pints per acre (32 percent w/v acid equivalent in a minimum of 20 gallons of water per acre). Moist warm conditions are conducive to good results. Cold weather and drought produce a delay in weed control action.

METHODS AND MATERIALS

Post-emergence Field Tests

A preliminary field investigation was conducted in the spring of 1959 using eight herbicides. The herbicides used in this study were: 2,3,6 - Trichlorobenzoic acid; 3 amino - 1,2,4 - Triazole; 4 (2,4 - Dichlorophenoxy) Butyric acid; 2,4,5 - trichlorophenoxypropionic acid; dL - alpha - (2 - methyl 4 - chlorophenoxy propionic acid amine salt; dL - alpha - (2 - methyl 4 - chlorophenoxy propionic acid potassium salt; Amine polychorobezoic acid; and 2 - chloro - 4,6 bis (ethylamino) - s - triazine. Findings of this study indicated that three chemicals, 2,4,5 - Trichlorophenoxypropionic acid (13 percent active ingredient); dL - alpha - (2 - methyl 4 - chlorophenoxy propionic acid amine salt (43 percent active ingredient); and dL - alpha - (2 - methyl 4 - chlorophenoxy propionic acid potassium salt (34.7 percent active ingredient) showed promise in control of henbit and chickweed in Kentucky bluegrass turf. The herbicidal properties of these chemicals were further investigated.

On April 10, 1960, these three chemicals were tested on established bluegrass turf which had a uniform infestation of henbit and chickweed. A treatment consisted of applying the chemical to a 3 foot by 3 foot plot with three randomized replications for each treatment. Herbicides were applied at the following rates: 0.5 cc., 1.0 cc., 2.0 cc., and 4.0 cc. in one gallon of water per plot. The chemicals were applied starting with the lowest concentration and progressing to the highest. The herbicides were applied with a single nozzle compressed air type sprayer at a pressure of 15 to 30 pounds per square inch. The spray equipment, after each chemical application, was throughly washed with one-half gallon of one percent ammonia water and then rinsed with three gallons of water. A wooden guard box two feet high was placed on each

plot prior to application of the herbicide to prevent possible drift of the chemical to other plots. One foot guard strips were maintained between plots.

A second application of the three herbicides were applied to the plots on April 25, 1960. Each chemical at half the initial concentration was applied to 4.5 square feet of the original 9 square foot treated plots.

Half concentration of the chemical was obtained by mixing the initial concentration in one gallon of water and then discarding two quarts of the solution. The remaining portion of solution was then made up to 1 gallon and applied using the same procedure as was used to apply the initial application.

The suggested technique of the NCR-10 Turf Committee (2) for crabgrass control experiments was used to evaluate the effectiveness of herbicides on henbit and chickweed. Turf injury ratings were based on the rating system of Nylund and Stadtherr (16): 0 = trace, 1 = slight, 2 = moderate, 3 = severe, 4 = very severe, and 5 = bluegrass dead.

Precipitation and temperature data were obtained from records of the Physics Department at Kansas State University, these data were recorded approximately 800 feet from the study area. (Table 2)

Post-emergence Greenhouse Tests

This phase of the study was conducted in a greenhouse to compare the effects of the herbicides on seedlings of chickweed, henbit, and Kentucky bluegrass. Henbit seeds were hand thrashed, then processed through various mesh screens. A screen with a .0394 inch diameter opening between strands of screen wire was initially used to remove any foreign material. After the primary screening process a .0328 inch, and .0165 inch screens were used to collect any remaining foreign particles. Henbit seeds were collected on the .0165 inch screen,

the latter screening being repeated four times as a final precaution to remove any foreign material. The same procedure was used for chickweed seed, the only alteration in the screening procedure being the addition of a .0098 inch screen; the smaller size of the chickweed seed requires the use of this additional screen.

Standard greenhouse flats used in this study were 15 inches by 22 and a half inches or 2.34 square feet. Based on a recommended rate of two pounds of Kentucky bluegrass seed per 1000 square feet, Keen and Quinlan (14), two grams of Kentucky bluegrass, 0.5 grams of henbit, and 0.5 grams of chickweed were planted per flat.

A count was made to determine the number of seeds in each sample. Three two gram samples were selected at random from thirty samples of bluegrass seed previously weighed. The samples were counted individually and then averaged. Henbit and chickweed seed samples were subjected to the same selecting and counting system employed for bluegrass. The results of the count were: bluegrass 7,300 seeds per 2.0 grams, henbit 2,512 seeds per 0.5 grams, chickweed 3,090 seeds per 0.5 grams. Thirty flats, previously measured, were filled with a growing medium consisting of two parts sterilized soil, one part sterilized sand, and one part of peat moss. Each flat was filled to a uniform depth of three inches and placed on the concrete floor of a 60°F night temperature greenhouse. All flats were elevated to provide adequate drainage. Prior to planting, each flat was leveled and firmed in order to eliminate any depression which might interfere with uniform distribution of seed and chemical.

The three herbicides used in this study were: 2,4,5 - Trichlorophenoxypropionic acid (13 percent active ingredient); dL - alpha - (2 - methyl 4 - chlorophenoxy propionic acid amine salt (43 percent active ingredient);

and dL - alpha - (2 - methyl 4 - chlorophenoxy propionic acid potassium salt (34.7 percent active ingredient.) There were three replications for each of the three treatments. Chemicals were applied on January 8, 1960, twelve days after planting when henbit and chickweed seedlings had developed their second pair of leaves and bluegrass seedlings varied from 1.8 cm. to 2 cm. in height (Plate I). Concentrations of herbicides used for each treatment were .025 cc., 0.5 cc., and 1.0 cc., per 180 cc. of solution. Herbicides were applied uniformly over the surface of the flats by using an applicator consisting of a medium sized sprinkler head (two holes per cm.) mounted on a six ounce bottle. To avoid contamination each flat was treated separately in the greenhouse head house.

A hygro-thermograph was placed adjacent to the flats in order to record temperature and humidity fluctuations (Table 1). Flats were rotated periodically to minimize any bias which might arise from the shadows cast by the greenhouse purlin and sash bars. A count of a random decimeter square portion of weeds and blue grass for each treatment was taken, two, five, and eight days after the herbicides were applied.

EXPLANATION OF PLATE I

Stage of growth of henbit, chickweed and bluegrass seedlings at which herbicides were applied.

PLATE I

Table 1. Turf greenhouse temperatures and relative humidity recordings for the period January 8 - 21, 1960.

Fahrenheit Temperature				Percent Relative Humidity			
Date	Maximum	Minimum	Average Daily Temperature	Date	Maximum	Minimum	Average Daily Temperature
Jan. 8	72	70	71	Jan. 8	82	78	80
9	80	68	74	9	80	70	75
10	70	68	69	10	72	70	71
11	70	64	67	11	80	60	70
12	76	67	72	12	69	55	62
13	74	64	69	13	70	69	69
14	68	64	66	14	80	72	76
15	72	60	66	15	82	78	80
16	84	68	76	16	84	72	78
17	78	70	74	17	75	70	73
18	80	68	74	18	78	68	73
19	74	70	72	19	81	72	77
20	68	64	66	20	82	70	76
21	80	72	76	21	78	72	75

Table 2. Temperature and rainfall data recorded at Kansas State University for the period April 5 - May 10, 1960.

Date	Fahrenheit Maximum Temp.	Fahrenheit Minimum Temp.	Rainfall	Date	Fahrenheit Maximum Temp.	Fahrenheit Minimum Temp.	Rainfall
April 5	63	36	0	May 1	70	30	0
6	70	46	0	2	75	47	0
7	67	35	T	3	79	55	0
8	59	35	.01	4	74	53	.05
9	53	30	0	5	78	58	.03
10	74	32	T	6	65	46	.71
11	74	61	0	7	64	35	.29
12	75	49	0	8	72	35	0
13	71	59	0	9	69	48	.61
14	76	47	.18	10	70	46	0
15	77	46	T				
16	81	52	0				
17	58	38	.03				
18	71	29	0				
19	80	50	0				
20	75	59	0				
21	84	41	0				
22	88	67	0				
23	81	66	T				
24	88	66	0				
25	79	57	T				
26	73	41	T				
27	72	45	0				
28	63	48	.26				
29	58	48	1.46				
30	53	35	.50				

RESULTS

Post-emergence Field Studies

Data on the comparative control of henbit, and chickweed, and on the relative turf damage for the three chemicals used are given in Table 3. An analysis of variance was made of these data to compare the effectiveness of each herbicide with the other herbicides at various concentrations in the control of henbit and chickweed. This analysis of variance was followed by use of the Fisher Least-Significant Difference Technique because even the second order interaction was significant ($P > .001$) for both henbit and chickweed. (Table 4)

Chickweed. Table 3 shows that the highest concentration of each herbicide produced the greatest percent kill of chickweed. Two herbicidal applications gave a more effective control than a single herbicide application. The initial spray of CMPP amine salt, at the four concentrations used produced significantly greater chickweed control than did the 2,4,5 TP and potassium salt herbicides at similar concentrations.

Henbit. Percent reduction of henbit seedlings (Table 3) by CMPP amine salt was significantly greater at the three higher concentrations when compared with 2,4,5 TP and CMPP potassium salt at similar concentrations. Two applications spaced fifteen days apart, with all herbicides produced significantly greater henbit control than did a single application (Table 3). CMPP amine salt gave a more effective control of henbit at the initial and second application when compared with 2,4,5 TP and CMPP potassium salt.

Bluegrass Discoloration. The first application of 2,4,5 TP and CMPP potassium salt at the two highest concentrations produced moderate discoloration to bluegrass whereas the initial application of CMPP amine salt at similar

Table 3. Effects of CMPP (Potassium salt), 2,4,5-TP and CMPP (amine salt) on henbit, chickweed and bluegrass*.

Concentration First Application	CMPP (potassium salt) Percent Control			2,4,5-TP Percent Control			CMPP (amine salt) Percent Control		
	Henbit	Chickweed	Bluegrass Discoloration	Henbit	Chickweed	Bluegrass Discoloration	Henbit	Chickweed	Bluegrass Discoloration
0.5 cc.	0	3.3	0	0	4.0	0	1	10.3	0
1.0 cc.	4.7	11.0	0	1.3	15.3	0	20.0	20.0	0
2.0 cc.	10.0	41.3	1.3	5.3	19.7	1.2	46.0	80.7	1.8
4.0 cc.	20.3	96.0	2.1	20.0	97.0	2.0	89.0	98.7	3.1
L.S.D. at 5 Percent	1.7%	1.9%		1.7%	1.9%		1.7%	1.9%	
Second Application	Henbit	Chickweed	Bluegrass Discoloration	Henbit	Chickweed	Bluegrass Discoloration	Henbit	Chickweed	Bluegrass Discoloration
.025 cc.	0.3	4.3	0	0.3	6.0	0	2.3	11.7	0
0.5 cc.	5.3	13.7	0.3	1.7	20.3	0	25.0	23.7	1
1.0 cc.	10.7	93.7	1.1	6.0	96.7	1.2	95.0	97.3	1.4
2.0 cc.	23.0	100.0	2.3	23.0	100.0	3.0	99.7	100.0	4

* Discoloration scale
1 - slight
2 - moderate
3 - severe
4 - very severe
5 - dead

Table 4. Analysis of variance indicating the comparison of CMPP (potassium salt), 2,4,5 TP and CMPP (amine salt) in the control of henbit and chickweed.

Source	D.F.		Ms		F		Sig.	
	Henbit	Chickweed	Henbit	Chickweed	Henbit	Chickweed	Henbit	Chickweed
Herbicide	2	2	12194.04	825.26	7717.75	565.25	***	***
Concent.	3	3	7318.17	3461231	4631.75	23707.06	***	***
H x C	6	6	2333.43	300.91	1476.85	206.10	***	***
Reps.	2	2	6.29	.38	3.98	.26	*	ns
Error (a)	22	22	1.58	1.46				
	35	35						
Sprayings	1	1	696.89	3612.50	696.89	2800.39	***	***
S x H	2	2	475.35	387.12	475.35	300.09	***	***
S x C	3	3	241.07	2384.61	241.07	1848.53	***	***
S x H x C	6	6	244.70	332.74	244.70	257.94	***	***
Error (b)	24	24	1.00	1.29				
	36	36						

* Significant
*** Highly significant

concentrations produced severe bluegrass discoloration. Two applications of CMPP potassium salt at the highest concentrations had moderate effects on bluegrass. A series of two spray applications of 2,4,5 TP and CMPP amine salt at the highest concentrations produced severe to very severe bluegrass discoloration.

Post-emergence Greenhouse Studies

At the time of herbicidal applications on January 8, the maximum daily temperature was 72°F; the minimum temperature was 70°F. These temperatures are recorded in Table 1. Observations were made daily after the sprays were applied to the flats in which henbit, chickweed, and bluegrass were growing. Comparisons were made of the effects of three herbicides on the control of henbit and chickweed seedlings and on their effects on bluegrass seedlings. On January 10, 1960, two days after herbicidal applications, there was noticeable twisting and curling of the weed seedlings in all treatments at 1.0 cc. concentrations. Bluegrass seedlings showed no sign of injury in any chemical treatments. Seven days after the sprays were applied bluegrass seedlings in all treated flats began to lose color. The first indication of herbicidal injury to bluegrass was at the highest concentrations for each chemical.

The seedlings were watered each day, however, on the eighth day after herbicidal application a structural collapse of bluegrass seedlings occurred following a light application of water. Untreated weed and grass seedlings retained their color and stature. Vegetation in all treated flats at the end of two weeks disappeared whereas, the untreated henbit, chickweed, and bluegrass continued to grow profusely. (Plate II)

EXPLANATION OF PLATE II

General appearance of all chemical treated flats as compared to untreated check, fifteen days after treatment.

PLATE II

DISCUSSION

Post-emergence Field Studies

It is readily apparent that, of the herbicides used, CMPP amine salt produced the most effective control of henbit and chickweed. The statistical analysis of these data showed that CMPP amine salt at all concentrations used for one or two herbicidal applications gave significantly better control of chickweed than did 2,4,5 TP and CMPP potassium salt at similar concentrations. Henbit control with CMPP amine salt was significantly better at all concentrations used when compared to 2,4,5 TP and CMPP potassium salt. Control was greatly increased by a series of two spray applications of CMPP amine salt. The initial application of CMPP amine salt produced severe bluegrass discoloration while 2,4,5 TP and CMPP potassium salt exhibited moderate bluegrass discoloration. Severe discoloration to bluegrass resulted from two spray applications of 2,4,5 TP and CMPP amine salt.

This field study indicated that one application of 2,4,5 TP at 1.0 cc., 2.0 cc., 4.0 cc. did not produce effective control of chickweed; however, Hogard and Hemphill (12) reported that 2,4,5 TP at 1.6 pounds per acre (approximately 1 cc. per 9 square feet) resulted in 100 percent control of chickweed. No reason can be offered for this apparent discrepancy. A series of two applications of 2,4,5 TP at the two highest concentrations was conducive to good control of chickweed. Literature pertaining to the herbicidal control of henbit could not be found. Control of henbit, as indicated by this study was not possible with 2,4,5 TP at the number of applications and concentrations used in this experiment.

Research workers in England (1) report that CMPP amine salt 32 percent active ingredient at six pints per acre (approximately 0.5 cc. per 9 square

feet) in a minimum of 20 gallons of water per acre was effective in controlling cleavers (Galium aparine). The use of CMPP amine salt on other weeds is based on the six pints of material per acre. Higher applications are suggested for the more resistant broad leaf weeds. Henbit and chickweed belong in this classification.

Early spring herbicidal application is important in the control of henbit and chickweed. These weeds being winter annuals grow and produce seed throughout the winter months. Heavy snowfall in March 1960 necessitated late herbicidal application. Weeds are most susceptible when they are small and growing rapidly. Spring application therefore, results in better control with less chemical. The herbicides used in this study were phytohormonal in nature. It is obvious therefore, that any factors affecting the absorption or the translocation of these herbicides will considerably modify the final result.

Manufacturers directions for the use of 2,4,5 TP state that temperatures must be over 35°F for at least one week following treatment. This naturally is beneficial not only from the standpoint of early control of weeds, but also during the cool months most ornamentals are dormant and unlikely to be injured by drift or accidental spray of 2,4,5 TP. Temperatures ranged from 42°F to 78°F in the course of this experiment. It is believed that temperature was not a factor in affecting the phytotoxicity of 2,4,5 TP in this experiment.

Climatic conditions affect the action of CMPP amine salt and potassium salt in the same way that they affect the action of other plant growth regulator herbicides. CMPP compounds were reported (1) to have maximum herbicidal activity when moist warm conditions prevail. The authors of the latter statement did not specify what they meant by warm and moist conditions. This present study showed that excellent control of chickweed and henbit at higher concentrations was realized using CMPP amine salt with a temperature range from

42°F to 78°F. It has been suggested (3 and 17) that the effects of high temperatures cause a high growth rate within the plant and that this is correlated with a greater susceptability to herbicides. It is believed that at higher temperatures in early spring the lower concentrations of CMPP amine salt and potassium salt would have resulted in more effective control.

Post-emergence Greenhouse Studies

The chemicals at the concentrations used were found lethal to weed and newly planted bluegrass seedlings. It is believed that controlled conditions of temperature, moisture, and lack of air circulation increased the herbicidal activity of each compound and possibly the chemicals did not react as they would have under outdoor conditions. It appears that the herbicides at the concentrations used under greenhouse conditions are lethal not only to henbit and chickweed seedlings but also to bluegrass seedlings.

SUMMARY

Three chemicals were tested in the field and greenhouse to determine their effectiveness as post-emergence herbicides in controlling henbit and common chickweed in Kentucky bluegrass and their effect on the growth and vigor of bluegrass.

The field study showed that the initial spray of CMPP amine salt at the four concentrations used produced significantly greater chickweed control than did 2,4,5-TP and CMPP potassium salt at similar concentrations. Two herbicidal applications for all herbicides produced more effective control of chickweed than one herbicide application.

Henbit control with CMPP amine salt was significantly better at all concentrations used when compared with 2,4,5-TP and CMPP potassium salt. Percent

control of henbit with CMPP amine salt was greatly increased by a series of two spray applications, whereas, for 2,4,5-TP and CMPP potassium salt percent control of henbit increased slightly with two spray applications.

The initial field application of CMPP amine salt for the control of henbit and chickweed produced severe bluegrass discoloration while 2,4,5-TP and CMPP potassium salt exhibited moderate bluegrass discoloration. Severe discoloration to bluegrass resulted with two spray applications of 2,4,5-TP and CMPP amine salt.

It is believed that low temperatures during the course of this field study affected the phytotoxicity of the CMPP compounds and possibly at higher temperatures the lower concentrations of these compounds would have resulted in more effective weed control. Temperature was not a factor in affecting the phytotoxicity of 2,4,5 TP.

In the greenhouse tests on henbit, chickweed and bluegrass all of the herbicides used were found lethal to weed and newly emerged bluegrass seedlings. Apparently controlled conditions of temperature, moisture and lack of air circulation increased the herbicidal activity of each compound and possibly the chemicals did not react as they would have under outdoor conditions.

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1960

Three chemicals were tested in the field and the greenhouse to determine their effectiveness as post-emergence herbicides in controlling henbit and common chickweed in Kentucky bluegrass turf and their effect on the growth and vigor of bluegrass turf. Two separate experiments were conducted.

An established bluegrass turf which had a uniform infestation of henbit and chickweed was sprayed with the following chemicals; 2,4,5 - Trichlorophenoxypropionic acid (13 percent active ingredient); dL - alpha - (2 - methyl 4 - chlorophenoxy propionic acid amine salt (43 percent active ingredient); and dL - alpha - (2 - methyl 4 - chlorophenoxy propionic acid potassium salt (34.7 percent active ingredient). A treatment consisted of applying the chemical to a 3 foot by 3 foot plot with three randomized replications for each treatment. Herbicides were applied on April 5, 1960 at the following rates, 0.5 cc., 1.0 cc., 2.0 cc., and 4.0 cc. in one gallon of water per plot. CMPP amine salt at the four concentrations used produced significantly better chickweed control than did 2,4,5-TP and CMPP potassium salt at similar concentrations. Two applications for all herbicides produced more effective control of chickweed than did one application.

Henbit control with CMPP amine salt was significantly better at all concentrations used when compared to 2,4,5-TP and CMPP potassium salt. Percent control for CMPP amine salt of henbit was greatly increased by a series of two spray applications, whereas, for 2,4,5-TP and CMPP potassium, percent control of henbit was increased slightly with two spray applications.

The initial field application of CMPP amine salt for the control of henbit and chickweed produced severe bluegrass discoloration while 2,4,5-TP and CMPP potassium salt exhibited moderate bluegrass discoloration. Severe discoloration to bluegrass resulted with two spray applications of 2,4,5-TP and CMPP amine salt.

Low temperatures were believed to have affected the phytotoxicity of the CMPP compounds, and possibly at higher temperatures the lower concentrations of these compounds would have resulted in more effective weed control. Temperature was not a factor in affecting the phytotoxicity of 2,4,5-TP.

The chemicals 2,4,5-TP, CMPP amine salt, and CMPP potassium salt were applied to flats in the greenhouse containing a uniform stand of henbit, chickweed and bluegrass seedlings. There were three replications for each of the three concentrations used and one check flat for each of the three treatments. Chemicals were applied on January 8, 1960, twelve days after planting, when henbit and chickweed seedlings had developed their second pair of leaves and the bluegrass seedlings varied from 1.8 cm. to 2 cm. in height. Concentrations of herbicides used for each treatment were; .025 cc., 0.5 cc., and 1.0 cc. per 180 cc. of solution. All herbicides at the concentrations used were found to be lethal to weeds and bluegrass seedlings. Control conditions of temperature, moisture and lack of air circulation were thought to have increased the herbicidal activity of each compound and possibly the chemicals did not react as they would have under outdoor conditions.